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CREEL CENSUS CONNECTICUT RIVER SHAD SPORT FISHERY, 1957-58, AND ESTIMATE OF CATCH, 1941-56

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Fish and Wildlife Service, Arnie J. Suomela, Commissioner
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by

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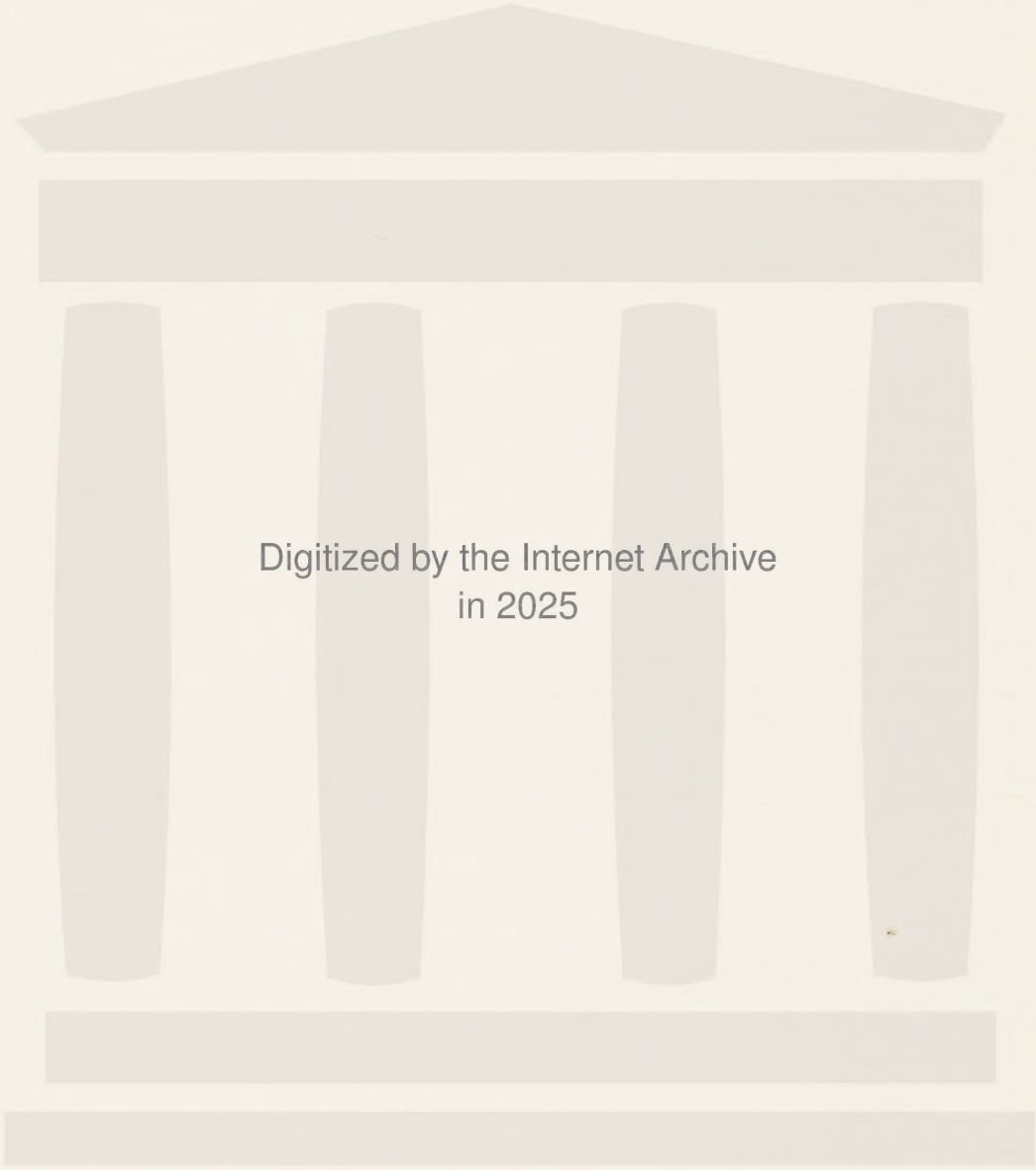

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ABSTRACT

Creel census surveys were conducted by the Bureau of Commercial Fisheries on the Connecticut River shad sport fishery during 1957 and 1958. In 1957 it was estimated that 34,310 shad were caught and kept in 19,901 fisherman days, and in 1958 an estimated 38,570 shad were caught and kept in 20,242 fisherman days. In 1958 the catch increased 12.4 percent, and the effort increased 14.1 percent over that in 1957. The average catch per fisherman day (1.7 shad) was identical for both years. The estimated sport catch for each year, 1941 through 1956, was determined by ratio estimate between catch at a state-controlled area and total catch for years 1957 and 1958.

The Bureau of Commercial Fisheries is the primary research agency of the Atlantic States Marine Fisheries Commission investigating the Atlantic coast shad fisheries. Objectives are to ascertain the causes for the decline in commercial yield of American shad *(Alosa sapidissima)* from a peak of 50 million pounds in 1896 to a low of 8 million pounds in 1950, to determine factors favoring recovery, and to provide basic information for fishery regulations to obtain maximum continuing yields.

It has been necessary to limit field work each year to specific areas, since funds and personnel have not been sufficient for a study of all the major shad runs simultaneously. Field studies to determine factors affecting the abundance of shad in the Connecticut River were begun in 1951 (Fredin 1954) and continued in 1956.[1] These studies, in part, indicated that the sport catch was significant and, therefore, a factor to be considered in the management of the fishery.

Only a limited amount of data were available on the sport fishery. Since 1941 the Connecticut State Board of Fisheries and Game has made an annual census of the shad taken and number of anglers at a state-controlled fishing area at Enfield Dam, Suffield, Conn. In 1950 the Branch of River Basins, U. S. Fish and Wildlife Service, conducted a creel census on the sport fishery in the Willimansett and South Hadley Bridge areas in Holyoke, Mass.[2] The survey showed that 3,168

[1] Unpublished report, U. S. Bureau of Commercial Fisheries Biological Laboratory, Beaufort, N. C.

[2] Mimeographed report, U. S. Fish and Wildlife Service, Branch of River Basins, Boston, Mass.

fishermen caught a total of 2,927 shad during the fishing season. In 1956 the Connecticut State Board of Fisheries and Game made an economic survey of the fishery and found that an estimated 2,003 fishermen made 16,618 fishing trips and caught and kept 18,823 shad from Connecticut waters. In addition, it was estimated that 7,500 were caught and released.

In the spring of 1957 and 1958 surveys were conducted by personnel of the Bureau of Commercial Fisheries to determine the total harvest by the sport fishery for 2 consecutive years. It was anticipated that with these data and those collected each year by the State, past and future years' sport catch could be estimated. These estimates could then be used in studies to determine the effect of changes in this fishery on the dynamics of the Connecticut River shad population.

The Connecticut State Board of Fisheries and Game made state-controlled area data available. Many sport fishermen cooperated to make the investigation possible. Conservation officers from Connecticut and Massachusetts, and boat rental operators at Windsor Locks, Conn. and Springfield, Mass. assisted. Water temperature records were obtained from the Hartford Light and Power Company, Hartford, Conn. and the Holyoke Water Power Company, Holyoke, Mass.

LIFE HISTORY AND DESCRIPTION OF THE RIVER AND FISHERY

American shad are the largest members of the herring family in the United States. They spend most of their lives in the sea, but ascend coastal rivers to spawn. These migrations begin in southern rivers as early as November and progressively later in northern rivers dependent on latitude. Adult shad native to rivers north of North Carolina normally do not die after spawning, and if they survive natural and fishing hazards, return to spawn in successive years. The young spend the first summer of life in the rivers and in the fall migrate to sea. In 3 to 6 years they reach sexual maturity and return to their native river to spawn (Talbot and Sykes 1958).

Sport fishing for shad first developed on the spawning grounds of the Salmon River at Leesville, Conn., located south of Hartford. This continued as the major shad sport fishing area until the flood of 1938 washed out the dam at Leesville. Since then the center of the sport has shifted to the Enfield Dam area on the Connecticut River at Suffield, Conn.[3] At present the fishery is localized in eight areas from the mouth of the Farmington near Windsor, Conn. to the South Hadley Bridge, Holyoke, Mass., a distance of approximately 30 miles (fig. 1). In addition to the major areas, the Scantic and Salmon Rivers support limited early season fishing. In this study the eight major areas are treated individually because of variations among them in type of fishing conducted, seasonal fishing pressure, and fishing success. The fishing areas, type of fishing in each area, and description of fishing grounds are given in table 1.

Sport fishing for shad in the Connecticut River and tributaries is characterized by a considerable variation in the lures used and in angling methods. Shad are taken by trolling from boats, drifting from bridges, and casting from the river bank. Lead bodied feathertailed jigs are usually fished from boats, small metal spoons from bridges, and plain hooks garnished with colored beads from river banks.

Shad enter the Connecticut River about the first week in April, and the run continues until the middle of June. The first fish are usually taken in the downriver sport fishing areas by the latter part of April, and first catches are made in Massachusetts waters about 3 weeks later. When catches are at a peak in Massachusetts, fishing has usually ended in the area below Enfield Dam.

The legal shad sport fishing season in Connecticut opens the third Saturday of April and usually closes the last Sunday in June, depending on fishing success at the state-controlled area. Prior to 1957 there was no creel limit, but at present a six-fish-per-day per angler limit prevails. Massachusetts has no restrictions on sport fishing for shad.

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[3] Unpublished ms. Shad fishery of the Connecticut River, 1944. Connecticut State Board of Fisheries and Game, Hartford, Conn.

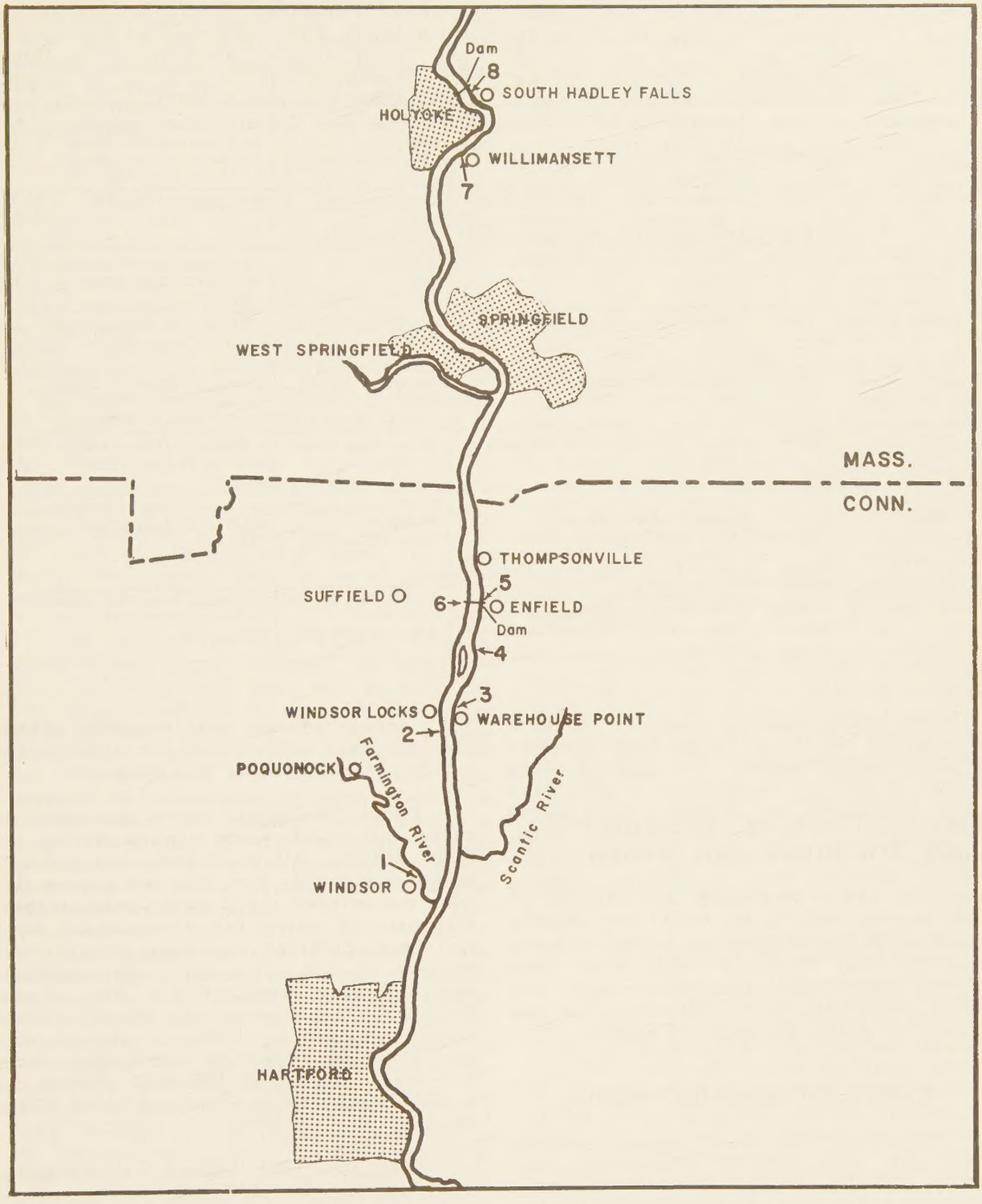

Figure 1.--Major shad sport fishing areas, Connecticut River, 1957-58.

Table 1.--Area, type of fishing, location of fishing grounds, and fishing season; shad sport fishery, Connecticut River, 1957 and 1958.

(See figure 1 for location of fishing areas.)

Area	Type of fishing	Location of fishing grounds	Fishing season	Remarks
Farmington River	Bank Boat	Upriver from Hwy. 5A Bridge, Windsor, Conn. Hwy. 5A Bridge downstream to mouth of river.	First to fifth week (April 20-May 25)	Water holding controls at Poquonock Dam cause low water by mid-season.
Windsor Locks boat rental	Bank Boat	One-half mile of west shore off Hwy. 5A in front of rental. Landing to Windsor Locks Bridge.	First to sixth week (April 20-June 1)	Low water by June 1.
Windsor Locks Bridge	Bridge	Deep water channels below bridge.	First to seventh week (April 20-June 8)	Low water affects availability of fish after June 8.
Kings Island	Boat	Rapids below the Enfield Dam.	Second to seventh week (April 27-June 8)	Boat passage hazardous at times of high and low water.
Enfield Dam east shore	Bank	Rapids below Enfield Dam off east shore.	Second to eighth week (April 27-June 15)	Low water after mid-season causes shift of river flow toward west shore.
State controlled area	Bank	Rapids below Enfield Dam off west shore.	Second week to end of season (April 27-July 1)	Low water affects availability of fish after July 1.
Willimansett Bridge	Bank Bridge Boat	Limited to both shores immediately below bridge. Deep water channels below bridge. One mile of river below bridge.	Fourth week to end of season (May 11-July 1)	Low water affects availability of fish after July 1.
South Hadley Bridge	Bank Bridge Boat	West shore channel below bridge. Deep water channels below bridge. One-half mile of river below bridge.	Fourth week to ninth week (May 11-June 25)	Low water caused by water holding controls at South Hadley Dam.

The water holding controls of dams located on the river cause daily fluctuations in water levels. The Enfield Dam forms a partial obstruction to fish passage at time of low water. A dam on the Farmington River at Poquonock, Conn. limits shad to the lower 5 miles of the river. Another dam at Holyoke, Mass., built in 1848, prevented the passage of fish beyond this point until 1955 when a mechanical lift fishway was installed. Since then several thousand shad have been passed above the dam each year. The effect this structure will have on the fishery in future years is not known.

CREEL CENSUS METHODS

Basically, the creel census methods employed consisted of observation and direct contact of bank and bridge fishermen and a voluntary reporting card system for boat fishermen. The sampling plan was patterned after the 5-day week check used by Best and Boles (1956) on Rush Creek and Castle Lake, Calif. During the 1957 survey a 6-day week sampling schedule was used, and during the 1958 census a 5-day week schedule was adopted.

Three biologists were assigned to make the 6-day week census during the 1957 season. All week ends and holidays were canvassed, and the same week day was not missed for 2 consecutive weeks. Estimate of catch for a noncensus week day was obtained by averaging census results on the same day in the previous and following week. Every day of the first and last week of the fishing season was canvassed in order to provide data for averages used in estimating catch for week days not checked during the second week and next to last week of the season.

Emphasis was placed on the lower river during the early part of the season, and as the season progressed and fishing shifted to upstream areas, assignments for coverage were shifted accordingly. Areas and time were allocated for contacting fishermen during the time of

maximum fishing. Daily coverage was on an 8-hour basis from 9:00 a.m. to 12:00 noon and from 2:00 p.m. to 7:00 p.m. Where feasible, adjacent fishing areas were covered by one man. Catch data were collected daily from the state-controlled area.

At bridge and bank areas, observations and counts were made hourly to determine rate of catch for estimating catch and effort for hours of non-coverage. Catch and effort for the 2 noncensused hours between 12:00 noon and 2:00 p.m. were obtained by averaging the results of the previous and following hour. The catch and effort figures determined from surveys conducted from 6:00 p.m. to 7:00 p.m. were doubled to obtain an estimate of number of shad caught and number of fishermen from 6:00 p.m. to end of fishing day (until dark). Few fish are caught after 6:00 p.m., and therefore any error caused by this approximation was negligible. Number of fishermen and number of shad caught and kept were recorded daily. No attempt was made to estimate number of shad caught and released.

To census the boat fishery, drop-in card boxes were mounted on posts at each boat-launching area with signs giving the purpose of the survey and requesting each fishing party to fill out a census card. Each card contained space to record number of male and female shad kept, number of fishermen in party, and date. Card number and landing site information were completed by the biologist. Enough census cards were attached to the boxes each day to make certain that one was available for each party.

The boats and boat fishermen were counted each census day by biologists working in the bank and bridge areas. In the early part of the season emphasis was placed on the boat areas, and the majority of the boat fishermen were contacted at the beginning and end of the fishing trip to acquaint them with the card system and to help them complete the census cards. Also, during the season "reminder cards" (creel census cards with an additional note) were placed on the windshields of boat-fishermen's cars to remind those acquainted with our system to fill out the card and to acquaint new fishermen with our program. The card boxes were checked each day, and the information obtained from completed cards was proportioned to the total boat count to estimate the day's catch. By doing this, many faults inherent in a creel census by the voluntary-type card system were nullified.

Prior to the 1958 survey, an effort was made to evaluate the method used the previous season. The 1957 6-day week sampling schedule was applied to the state-controlled area catch data. Results showed less than 1 percent error in estimating the catch. Because funds and personnel were not sufficient for a 6-day sampling schedule in 1958, a hypothetical 5-day week census, including all week ends and holidays, was applied to the 1957 state-controlled area catch data. Results showed less than 3 percent error from the known catch, and therefore a 5-day week sampling schedule was adopted for the 1958 study. Two biologists were assigned to make the census during the 1958 season. In all other respects the 1957 and 1958 creel census methods were the same. Scale samples and length-weight data by sex were collected from the catch throughout both seasons.

The Salmon and Scantic Rivers were checked during both years. Most of the shad caught in these rivers were taken by trout fishermen during the early part of the season. Approximate estimates of fishing success and effort were calculated from data obtained from weekly angler interviews. Since the catch in these areas was small, little error was introduced into the total sport catch estimate by these approximations.

ANALYSIS OF RESULTS

In 1957 the estimated catch for bank and bridge fishing was based on the 6-day week sampling schedule and the boat catch was estimated from a 37.3-percent return of census cards. In 1958 the estimated catch for bank and bridge fishing was based on the 5-day week sampling schedule and the boat catch on 43.5-percent return of census cards. Returns of boat fishermen cards by area in 1957 were: Farmington River--42.4 percent; Windsor Locks--27.1 percent; Kings Island--70.3 percent; and Willimansett Bridge--29.3 percent. Percentage card return during the 1958 season showed a slight increase

in each area except Willimansett Bridge which slightly decreased.

1957 Creel Census

The sport fishing season extended for 10 weeks, from April 20 through June 27, and during this period an estimated 34,310 shad were caught and kept (table 2). Of this total, 20,169 were males and 14,141 were females. The estimated fishing effort was 19,901 fisherman-days. Of this total, 8,831 were bank fishermen; 6,735 were bridge fishermen; and 4,335 were boat fishermen. Average catch per fishermen-day was 1.7 shad. Fisherman-days represent the actual number of anglers fishing on any one day; therefore, an individual fisherman may have fished more than 1 day.

1958 Creel Census

The sport fishing season extended for 11 weeks, from April 19 through July 2, and during this period an estimated 38,570 shad were caught and kept (table 3). Of this total, 20,242 were males and 18,328 were females. The estimated fishing effort was 22,706 fisherman-days. Of this total, 11,117 were bank fishermen; 6,424 were bridge fishermen; and 5,165 were boat fishermen. The average catch per fisherman-day was 1.7 shad.

Comparison of Results

The 1958 season showed increases of 4,260 fish (12.4 percent) and 2,805 fisherman-days (14.1 percent) over 1957. Part of the increase may be due to the longer season in 1958. The number of bank and boat fishermen in 1958 showed a substantial gain over that in 1957, whereas the number of bridge fishermen decreased.

Table 4 summarizes the weekly shad catch by state for the two seasons. The Connecticut catch in 1958 increased 2,799

Table 2.--Summary of estimated shad catch and effort by fishing area, Connecticut River sport fishery, 1957.

Area	Number of boats	Fisherman days				Number of fish taken			Average catch per fisherman day
		Bank	Bridge	Boat	Total	Male	Female	Total	
1. Farmington River	158	430	-	315	745	425	219	644	0.9
2. Windsor Locks boat rental	706	1,148	-	1,615	2,763	2,776	1,278	4,054	1.5
3. Windsor Locks Bridge	-	-	2,365	-	2,365	1,904	1,200	3,104	1.3
4. Kings Island	350	-	-	887	887	1,691	2,431	4,122	4.6
5. Enfield Dam east shore	-	1,496	-	-	1,496	2,139	1,296	3,435	2.3
6. State controlled area	-	5,090	-	-	5,090	4,600	4,748	9,348	1.8
7. Willimansett Bridge	622	53	3,937	1,481	5,471	5,707	2,671	8,378	1.5
8. South Hadley Bridge	15	414	427	37	878	684	237	921	1.0
9. Scantic and Salmon Rivers	-	200	[illegible]	-	206	243	61	304	1.5
Total	[illegible]	[illegible]	6,735	4,335	19,901	20,169	14,141	34,310	1.7

Table 3.--Summary of estimated shad catch and effort by fishing area, Connecticut River sport fishery, 1958.

Area	Number of boats	Fisherman days				Number of fish taken			Average catch per fisherman day
		Bank	Bridge	Boat	Total	Male	Female	Total	
1. Farmington River	153	1,022	-	322	1,344	647	358	1,005	0.7
2. Windsor Locks boat rental	742	1,388	-	1,466	2,854	2,442	1,635	4,077	1.4
3. Windsor Locks Bridge	-	-	2,644	-	2,644	2,269	1,578	3,847	1.4
4. Kings Island	381	-	-	964	964	1,633	2,782	4,415	4.6
5. Enfield Dam east shore	-	1,713	-	-	1,713	1,944	1,635	3,579	2.1
6. State controlled area	-	5,842	-	-	5,842	4,827	5,758	10,585	1.8
7. Willimansett Bridge	1,015	20	2,897	2,334	5,251	5,348	3,929	9,277	1.8
8. South Hadley Bridge	36	932	878	79	1,889	892	593	1,485	0.8
9. Scantic and Salmon Rivers	-	200	5	-	205	240	60	300	1.5
Total	2,327	11,117	6,424	5,165	22,706	20,242	18,328	38,570	1.7

Table 4.--Weekly estimated sport catch of shad by State, Connecticut River, April 20-June 27, 1957 and April 19-July 2, 1958.

Week	Connecticut		Massachusetts		Total	
	1957	1958	1957	1958	1957	1958
1	301	0	0	0	301	0
2	2,310	36	0	0	2,310	36
3	3,446	803	34	0	3,480	803
4	5,028	2,446	140	0	5,168	2,446
5	4,786	7,829	519	203	5,305	8,032
6	5,833	8,340	[illegible]	2,440	8,885	10,780
7	2,291	3,709	3,403	2,135	5,694	5,844
8	847	2,476	2,000	3,177	2,847	5,653
9	67	1,277	250	2,085	317	3,362
10	0	651	3	755	3	1,406
11	-	141	-	67	-	208
Total	24,909	27,708	9,401	10,862	34,310	38,570

fish over that in 1957, while the Massachusetts catch increased 1,461 fish. In both seasons Connecticut waters accounted for approximately 72 percent of the catch and 68 percent of the effort.

Tables 5 and 6 give the general statistics for the two seasons for each type of fishing in Massachusetts, Connecticut, and Connecticut River tributaries. In Massachusetts, boat fishermen accounted for the greater part of the catch, while in Connecticut most fish were taken by bank fishermen. For the entire basin, bank fishermen accounted for 43.9 percent of the catch in 1957 and 44.2 percent in 1958. Boat fishermen took 35.1 percent of the total catch in 1957 and 37.6 percent in 1958. Bridge fishermen accounted for 21.0 percent of the total catch in 1957 and 18.2 percent in 1958. During both seasons most anglers fished from bridges in Massachusetts, whereas in Connecticut most fished from shore. Boats were used by the least number of fishermen, yet fishing success was best by this group. The average catch of 1.7 shad per fisherman-day for all fishing was identical for both seasons.

Figure 2 illustrates the weekly fishing success for the two seasons. During 1957 and 1958 the best catches were made from the middle of May through the first week of June. Peak fishing effort occurred on week ends and holidays and the low on Monday. Peaks of daily fishing effort occurred from 9:00 a.m. to 11:00 a.m. and from 4:00 p.m. to 6:00 p.m.

The water temperature increased from 52° to 82° F. during the 1957 season and from 46° to 81° F. in 1958, with little temperature change from day to day. During both seasons fishing success was usually poor at water temperatures of 47° to 52° F. and 75° to 80° F. Success was greater at water temperatures between 57° to 71° F., with peak success at 67° to 69° F., which occurred between May 11 and May 31 during 1957 and May 24 through June 7 in 1958.

Table 5.--Calculated shad catch, effort, and catch per unit of effort by type fishing and fishing waters, Connecticut River and tributaries, 1957.

Type fishing	Connecticut River (in Massachusetts)			Connecticut River (in Connecticut)			Farmington River and other tributaries			Complete basin		
	Number fish	Number fisherman days	Catch per fisherman day	Number fish	Number fisherman days	Catch per fisherman day	Number fish	Number fisherman days	Catch per fisherman day	Number fish	Number fisherman days	Catch per fisherman day
Bank	[illegible]	407	[illegible]	14,046	7,7[illegible]	1.[illegible]	939	936	1.0	15,071	8,831	1.7
Boat	[illegible]	[illegible]	[illegible]	7,101	2,5[illegible]	2.8	303	315	1.0	12,691	4,355	2.8
Bridge	[illegible]	[illegible]	[illegible]	5,[illegible]	2,365	1.3	6	6	1.0	7,208	6,735	1.1
Total	[illegible]	[illegible]	1.5	24,[illegible]	12,601	1.9	948	951	1.0	34,310	19,901	1.7

Table 6.--Calculated shad catch, effort, and catch per unit of effort by type fishing and fishing waters, Connecticut River and tributaries, 1958.

Type fishing	Connecticut River (in Massachusetts)			Connecticut River (in Connecticut)			Farmington River and other tributaries			Complete basin		
	[illegible]	Number fisherman days	Catch per fisherman day	[illegible]	Number fisherman days	[illegible]	[illegible]	Number fisherman days	Catch per fisherman day	Number fish	Number fisherman days	Catch per fisherman day
Bank	[illegible]	[illegible]	.[illegible]	15,[illegible]	8,[illegible]	[illegible]	[illegible]	[illegible]	.[illegible]	17,[illegible]	11,117	1.5
Boat	[illegible]	[illegible]	[illegible]	[illegible]	2,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14,517	5,165	2.8
Bridge	[illegible]	[illegible]	[illegible]	6,574	5,[illegible]	1.1	[illegible]	5	[illegible]	7,[illegible]	6,424	1.1
Total	[illegible]	[illegible]	[illegible]	[illegible]	14,[illegible]	[illegible]	1,[illegible]	1,549	0.8	38,570	22,706	1.7

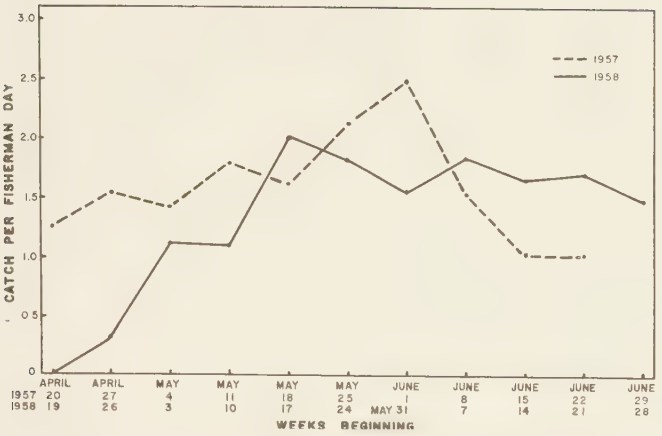

Figure 2.--Weekly fishing success for shad on Connecticut River, 1957 and 1958.

COMPOSITION OF THE CATCH

In the early part of the season practically all shad landed were kept irrespective of size or sex because the fish were less abundant than at any other time during the season. As the season progressed and fishing was more successful, fishermen released many small shad (usually males). Fishermen preferred females regardless of size because the roe is considered a delicacy. Towards the end of the season, many shad of both sexes were released because their condition was poor. Males predominated during the early part of the run, and females predominated from the middle to the end of the run.

Scale samples were collected during both seasons. These were read for total age and number of times previously spawned, using a method developed by Cating (1953). Table 7 gives a summary of the age distribution and spawning history by sex of fish sampled. The number of shad which had spawned the previous season was relatively constant for both years: 14.2 percent in 1957 and 14.6 percent in 1958. In 1957 the males were predominantly 3, 4, and 5 years old, and each of these age groups was present in about equal proportions. The females in 1957 were predominantly 5 years old. During the 1958 season the majority of males were 4 years old, while the majority of the females were 5 years old.

The average fork length by sex (15.6 inches for males and 18.7 inches for females) showed no significant difference

Table 7.--Age distribution and spawning history by sex of sampled shad, Connecticut River sport fishery, 1957-58.

Group	1957				1958			
	Female		Male		Female		Male	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Age at capture: (years)								
2	-	-	2	0.2	-	-	1	0.1
3	3	0.4	314	33.3	3	0.4	161	21.5
4	77	10.1	265	28.1	283	36.2	426	56.8
5	566	74.2	319	33.9	379	48.5	113	15.1
6	109	14.3	40	4.2	108	13.8	44	5.9
7	8	1.0	2	0.2	7	0.9	4	0.5
8	-	-	-	-	1	0.1	1	0.1
Total	763	-	942	-	781	-	750	-
Initial spawners	644	84.4	819	86.9	690	88.3	618	82.4
Previous year spawners	119	15.6	123	13.0	91	11.6	132	17.6

between the two seasons. The average weight by sex (2.3 pounds for males and 3.6 pounds for females) showed no significant difference between the two seasons. The smallest fish appearing in the catch were 2-year-old males which averaged 11.2 inches in fork length (range 10.7-11.8) and 0.8 pounds in weight (range 0.7-0.9). The largest fish appearing in the catch were 7-year-old females which averaged 19.8 inches in fork length (range 17.8-21.2) and 4.6 pounds in weight (range 3.8-6.1).

ESTIMATED SPORT CATCH, 1941-56

Catch data for the state-controlled area were made available by the Connecticut State Board of Fisheries and Game for each year since 1941. Fishermen using this area are required to purchase a permit for each day's fishing from the custodian of the area. At the end of the day's fishing trip, the permits are returned and the custodian checks and records each catch. Records are collected by the same personnel and in the same manner each year. During the 2-year creel census, catches for the area were copied from the custodian's logbook.

The state-controlled area catch together with the 1957 and 1958 creel census results were used to calculate total sport catch from 1941 through 1956 using the method of ratio estimate described by Cochran (Snedecor 1956). In this study, the ratio estimate (R) is the weighted mean of the ratio of the known catch at the state-controlled area (Y) and the estimated total catch of the Connecticut River sport fishery (X). Using the 1957 and 1958 data, the following value was obtained:

$$R = \frac{\Sigma Y}{\Sigma X} = \frac{9,348 + 10,585}{34,310 + 38,570} = 0.2735$$

which indicates that an average of 27.35 percent of the total catch was made at the state-controlled area. Ninety-five percent confidence limits on the ratio estimate were ± 0.0000122. The ratio between the catch at a state-controlled area and the total catch was relatively constant for the 2 years sampled: 0.2724 in 1957 and 0.2744 in 1958.

The estimated sport catch for years 1941-56, using the ratio estimate 0.2735, was determined as shown in table 8 and graph, figure 3. The catch decreased from 35,600 in 1944 to a low of 12,400 in 1950. Between 1951 and 1956 the catch fluctuated from 13,400 to 19,900. The peak catch of 35,600 in 1944 was associated with increased fishing effort since the state-controlled area data shows 18,913 total hours fished during that year compared to 8,033 hours fished in 1943 and 10,103 in 1945. Both 1957 and 1958 produced high catches, reaching a peak of 38,570 in 1958.

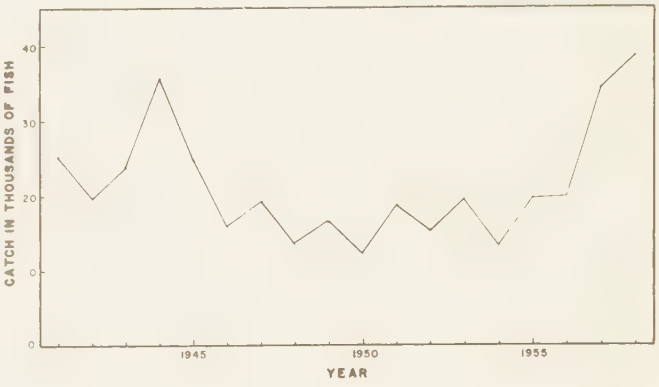

Figure 3.--Estimated total sport catch, Connecticut River, 1941-58.

On the basis of the following data, it is assumed that no change occurred in conditions which would affect the ratio between the catch at a state-controlled area and the total catch for years 1941 to 1956. The 1950 creel census by the U. S. Fish and Wildlife Service in Massachusetts waters revealed that the catch was 2,927 shad, which represents approximately 24 percent of the calculated total catch by ratio estimate for the same year. This compares very closely with the 1957 and 1958 results in which 27 and 28 percent, respectively, of the estimated catch was made in Massachusetts. In 1956 it was estimated by the Connecticut State Board of Fisheries and Game that the number of shad caught by sport fishermen in Connecticut waters was 18,823. This represents approximately 94 percent of the estimated total catch by ratio estimate for the same year and is comparable to the 1957 and 1958 findings. Additional evidence is shown by the consistency of the between-area catch ratios in 1957 and 1958 (tables 2 and 3). From the data available it appears that the between-area catch ratio has remained relatively constant.

Table 8--Summary of state-controlled area catch and effort data and estimated total catch as determined by ratio estimate, Connecticut River shad sport fishery, 1941-56.

Year	State controlled area			Estimated total catch (to nearest 100)
	Fisherman days (number)	Catch (number)	Catch per fisherman day	
1941	3,449	6,859	2.0	25,100
1942	5,172	5,395	1.0	19,700
1943	2,340	6,519	2.8	23,800
1944	5,110	9,730	1.9	35,600
1945	5,512	6,752	1.2	24,700
1946	5,280	4,385	0.8	16,000
1947	5,036	5,284	1.1	19,300
1948	4,321	3,728	0.9	13,600
1949	4,800	4,566	1.0	16,700
1950	3,632	3,392	0.9	12,400
1951	4,357	5,102	1.2	18,700
1952	4,830	4,177	0.9	15,300
1953	5,046	5,337	1.1	19,500
1954	4,487	3,671	0.8	13,400
1955	4,237	5,396	1.3	19,700
1956	4,193	5,451	1.5	19,900
1957	5,090	9,348	1.8	34,300 1/
1958	5,842	10,585	1.8	38,600 1/

1/ Creel census results included for comparison

From the above discussion it appears that sport catch as determined by ratio estimate can be considered a fair approximation of the actual catch. However, in the future if additional areas are fished, fishing methods change, or physical changes occur in the river, another census will be required to determine if this ratio is still valid.

SUMMARY

In 1957 and 1958, creel census surveys were conducted by the Bureau of Commercial Fisheries on the Connecticut River shad sport fishery as a part of a continuing study on this fish population.

Sport fishing for this species is localized in eight areas from the mouth of the Farmington River near Windsor, Conn. to the South Hadley Bridge, Holyoke, Mass., a distance of approximately 30 miles. Fish are taken from boats, bridges, and river banks with artificial lures.

The methods employed to census the fishery were observation and direct contact of bank and bridge fishermen and a voluntary reporting card system for the boat fishermen. During the 1957 survey, a 6-day week sampling schedule was used, and during the 1958 survey a 5-day week schedule was adopted.

It was estimated that 34,310 shad were caught and kept in 19,901 fisherman-days during the 1957 season, and in 1958 an estimated 38,570 fish were caught and kept in 22,706 fisherman-days. The average catch per fisherman-day was identical

for both seasons: 1.7 shad. Bank fishermen accounted for 43.9 percent of the catch in 1957 and 44.2 percent in 1958. Boat fishermen landed 35.1 percent of the catch in 1957 and 37.6 percent in 1958. Bridge fishermen took 21.0 percent in 1957 and 18.2 percent in 1958. In both seasons Connecticut waters accounted for approximately 72 percent of the catch and 68 percent of the effort.

In 1957 male shad in the catch were predominantly 3, 4, and 5 years old and were present in approximately equal numbers. The females in 1957 were predominantly 5 years old. In 1958 male shad in the catch were predominantly 4 years old, while the majority of females were 5 years old. The average fork length of shad for years 1957 and 1958 was 15.6 inches for males and 18.7 for females. The average weight of shad for years 1957 and 1958 was 2.3 pounds for males and 3.6 pounds for females.

Creel census data obtained in 1957 and 1958, together with catch records collected at the state-controlled area, were used to estimate the total shad catch by the sport fishery, 1941 through 1956. The catch decreased from 35,600 in 1944 to a low of 12,400 in 1950. Between 1951 and 1956 it fluctuated from 13,400 to 19,900. Both 1957 and 1958 produced high catches reaching a peak of 38,570 in 1958.

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